Past Papers Questions:

3.4 Data Representation, Data Structures and Data Manipulation

May/June 2003

2 The data Nile, Zambesi, Amazon, Indus, Thames, Volga, Danube and Mississippi are to be entered into a binary tree in that order so that later these names can be extracted in alphabetical order.

(a) Draw the representation of the binary tree with this data held in it. [3]
(b) Describe how to insert a new value correctly into this tree. [4]

October / November 2003

6 Using an 8 bit byte for the mantissa (fraction) and another 8 bit byte for the exponent (characteristic)

(a) show
(i) 10½
(ii) -10½
as 2 byte, normalised, floating point numbers. [4]

(b) Show the bit pattern that represents
(i) the largest positive
(ii) the smallest magnitude negative
number that can be represented using this 2 byte normalised floating point form. [4]

May/June 2004

6 (a) Represent
(i) +102,
(ii) +117
as 8-bit numbers in two's complement form. [2]

(b) (i) Add the answers in part (a) together to give a binary result. [2]
(ii) Turn your binary answer into an equivalent denary result. [2]
(iii) Explain the validity, or otherwise, of your result. [2]

(c) A stack is to be held in an array. With the aid of a diagram, explain how an item may be
(i) added to,
(ii) deleted from
the stack, while maintaining the integrity of the structure. [6]

October/November 2004

6 (a) Express the denary value 109 as
(i) a binary number using an 8-bit byte;
(ii) an octal number;
(iii) a hexadecimal number. [6]

(b) Numbers are held in floating point form with one byte for the mantissa (fraction) and one byte for the exponent (characteristic). All values are held in two's complement form and the mantissa is normalised.
Using this format, write down the binary floating point values and the denary values of
(i) the largest magnitude, positive number;
(ii) the smallest magnitude, positive number;
(iii) the largest magnitude, negative number;
(iv) the smallest magnitude, negative number.
(The denary values may be left as a product of a power of 2). [8]

(c) Explain how accuracy can be improved in a floating point representation and state an effect it can have on the number represented. [3]

May/June 2005

3 Two lists of numbers need to be combined into a single list which will be in numerical order, smallest first.

List A: 2 3 8 11 17
List B: 7 10 5 6 9

(a) By showing each of the stages, describe how list B can be sorted into numerical order using an insertion sort. [4]

(b) Explain how list A and the sorted list B can be merged to give a complete, sorted, set of numbers. [6]

7 (a) Express the denary number 78 as
(i) a binary number stored in an 8 bit byte,
(ii) a hexadecimal number,
(iii) a number stored in binary coded decimal (BCD). [6]

(b) Explain how the binary value of 78 can be used to write down the equivalent octal value with a minimum amount of calculation [3]

(c) (i) Convert -63 and -94 into 2's complement, 8 bit, binary numbers. [2]
(ii) Add the binary values obtained in (i) together. [2]
(iii) Comment on the result that you obtained in (ii). [2]

October/November 2005

May/June 2006

8 (a) Explain the difference between a dynamic data structure and a static data structure, giving an example of each. [3]

(b) A list of the names of students in a college is stored in an array of size 1000. The names are stored in no logical order, simply in the order that they were input to the array.
(i) Give one advantage and one disadvantage of storing this list of names in an array. [2]

(ii) In whatever form you choose, describe an algorithm for finding the location in the array of a specific name 'X', using a serial search. [5]

(iii) An alternative way of storing the names is to store them in alphabetical order within the array. Explain how this will affect the management of the storage and the search for specific names. [4]

October/November 2006

5 (a) Express the decimal number 109 as
(i) a binary number stored in an 8 bit byte; [2]
(ii) a number in binary coded decimal (BCD); [2]
(iii) a hexadecimal number. [2]

(b) A particular computer stores numbers as 8 bit, two's complement, binary numbers.
01011101 and **11010010** are two numbers stored in the computer.

(i) Write down the decimal equivalent of **11010010**. [2]
(ii) Add the two binary values together and comment on your answer. [3]

May/June 2007

3 Jobs that require printing, by a network printer, are stored until the printer is ready. Their addresses are placed in a queue to await their turn for printing. Addresses of new jobs are placed at one end of the queue. These job addresses are taken from the other end when the printer is ready.

(a) State two reasons why it would be preferable to store the queue in a linked list rather than an array. [2]

(b) If the queue is held in a linked list, describe an algorithm for
(i) inserting an address into the queue,
(ii) reading an address from the queue. [5]

9 A computer stores numbers in floating point form, using 8 bits for the mantissa and 8 bits for the exponent. Both the mantissa and the exponent are stored in two's complement form.

(a) Explain the effect on the
- range
- accuracy

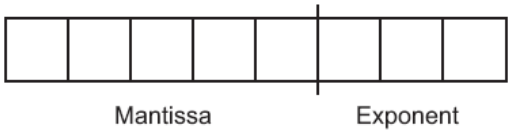
of the numbers that can be stored if the number of bits in the exponent is reduced. [4]

(b) Give the denary number which would have 01000000 00000000 as its binary, floating point representation in this computer. [2]

(c) Explain why it is not possible to represent zero as a normalised floating point number. [2]

October/November 2007

10 A computer stores fractional numbers in floating point binary representation. Five bits are used for the mantissa and three bits for the exponent. All values are stored in two's complement form.



(a) By using a diagram of this representation, state the value of each of the bits. [4]
(b) By using 2 ½ as an example, explain how real numbers can be shown in normalised form in this representation. [3]
(c) State the floating point binary value of - ¾ in this representation. [2]

May/June 2008

4 (a) (i) Express the number 93 as an 8 bit binary number. [2]
(ii) Express the number 93 as a number in octal. [2]
(iii) Express the number 93 as a number in hexadecimal. [2]

(b) (i) Explain how to use the binary representation of a number to work out its value in octal. [2]
(ii) Describe the connection between binary representation and hexadecimal. [2]

7 *List A* is 2,4,7,9
List B is 15,3,8,10,1
These two lists are to be merged into one list in numerical order, smallest first.

(a) List B must first be sorted into order.
Describe how an insertion sort can be used to do this. [4]
(b) After both lists have been sorted they are to be combined into a single list in numerical order. Describe how a merge sort can be used to do this. [4]